Extreme Thermal Environmental Tests Of Plastic Encapsulated COTS

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Presentation outline

- Motivation
- Objectives
- Samples
- Sample pre-Examinations
- Test Methods
- Sample post-Examinations
- Conclusions

Motivation

- **To understand the limits of the long-term reliability problems of the improved plastic encapsulated microelectronic COTS parts especially in extreme thermal cycle environments.**
- **To evaluate the nondestructive C-SAM technique whether the technique can be used as a potential faster, cheaper, and better method for ways to detect failure mechanism and perform device package qualification.**

Objectives

Provide parts engineering risk analysis to NASA flight programs/instruments through:

- **The performance of evaluations and tests on high risk COTS parts/packages**
- **Identify risks associated with very low temperature applications**
- **Development of new methods to ascertain risk and performance or parts under extreme space environments**
- **Development of means to reduce cost of qualifying parts while insuring reliability and performance**

Samples Tested

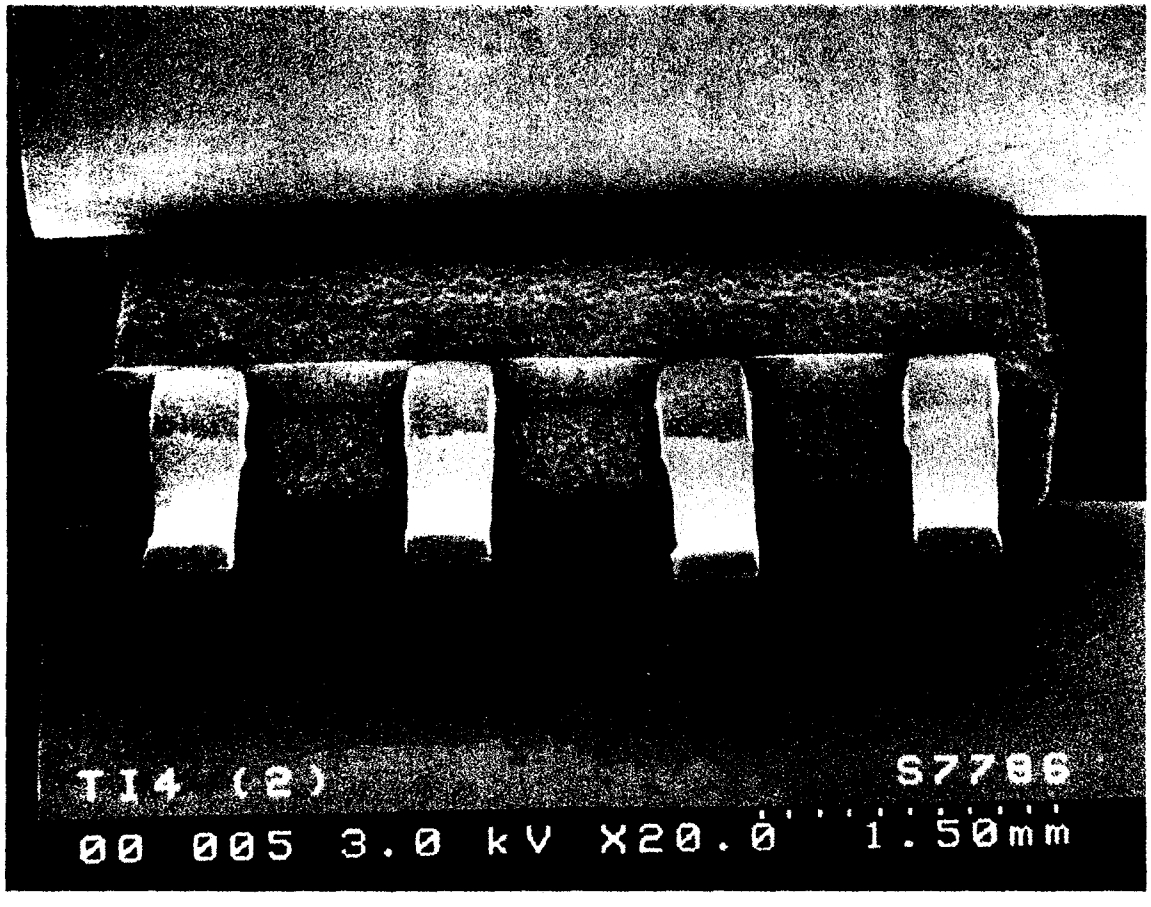
MAAM12031	**Qty 2 each,**
EC-5117	**Qty 2 each,**
HMC194MSB	**Qty 2 each,**
OPA2340EM	**Qty 2 each,**
EC-5007	**Qty 2 each,**
RF2128P	**Qty 2 each,**
TL072A	**Qty 1 each.**

Visual Inspection

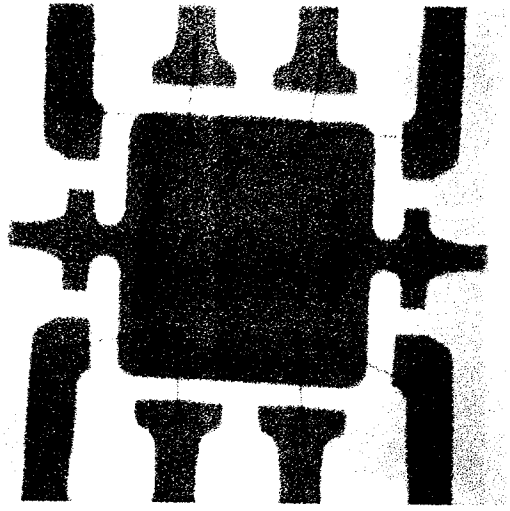
Top View

Bottom View

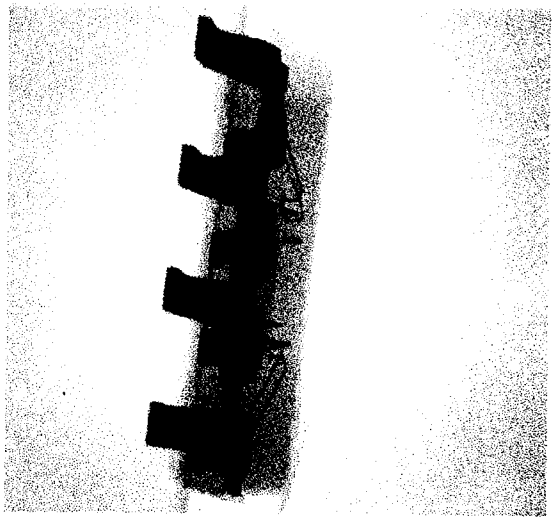
Pre-Test Examination
SEM



Pretest Examination
X-ray

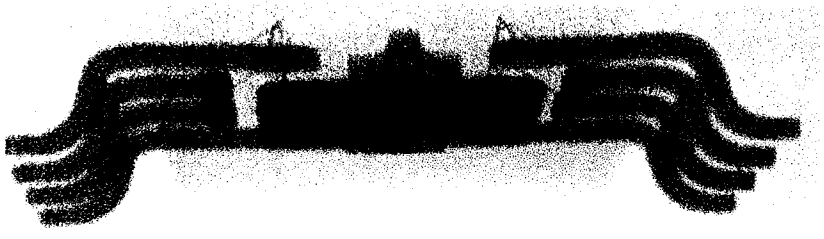


Top View
TL072AC

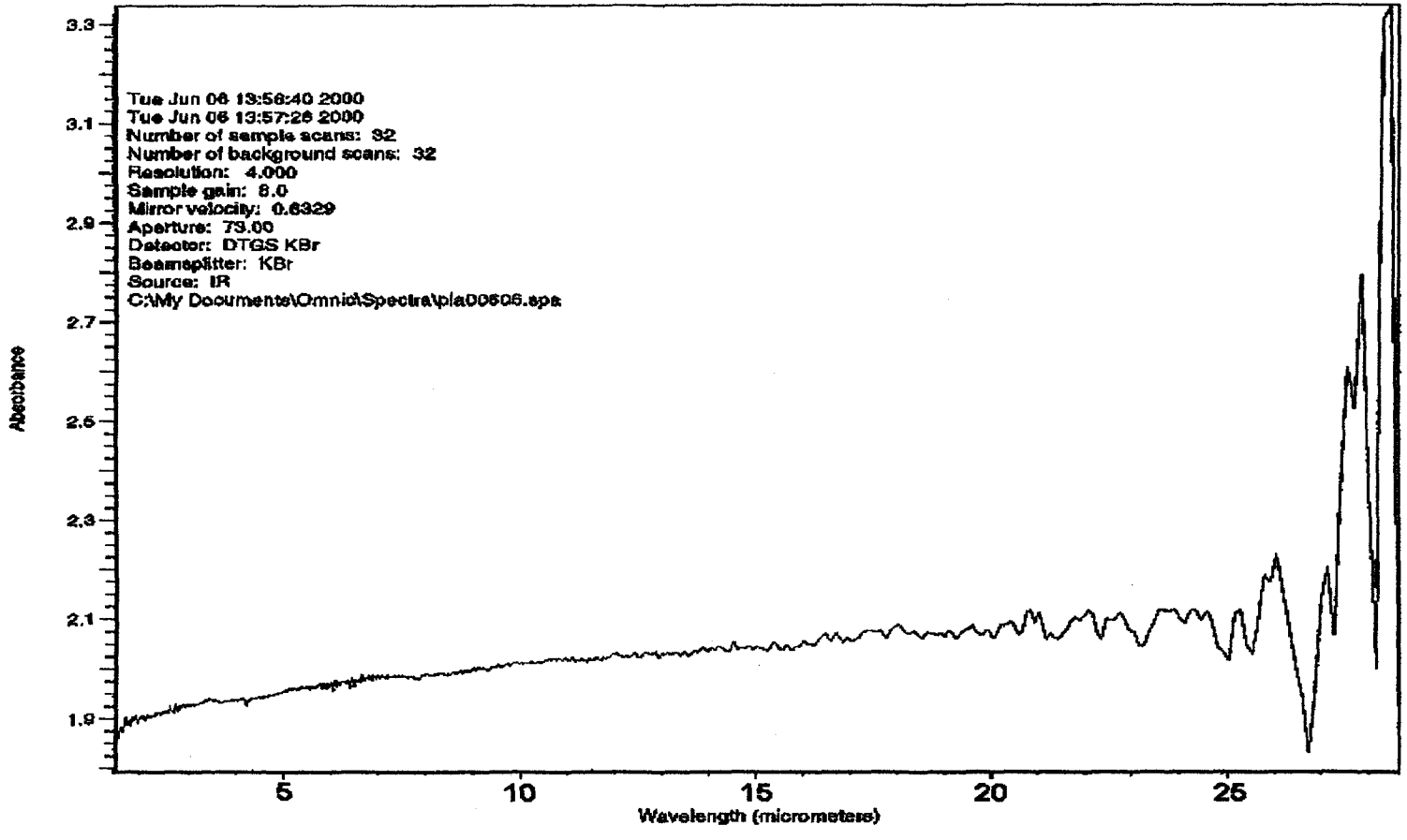


Side View
TL072AC

Bird-Eye View
TL072AC



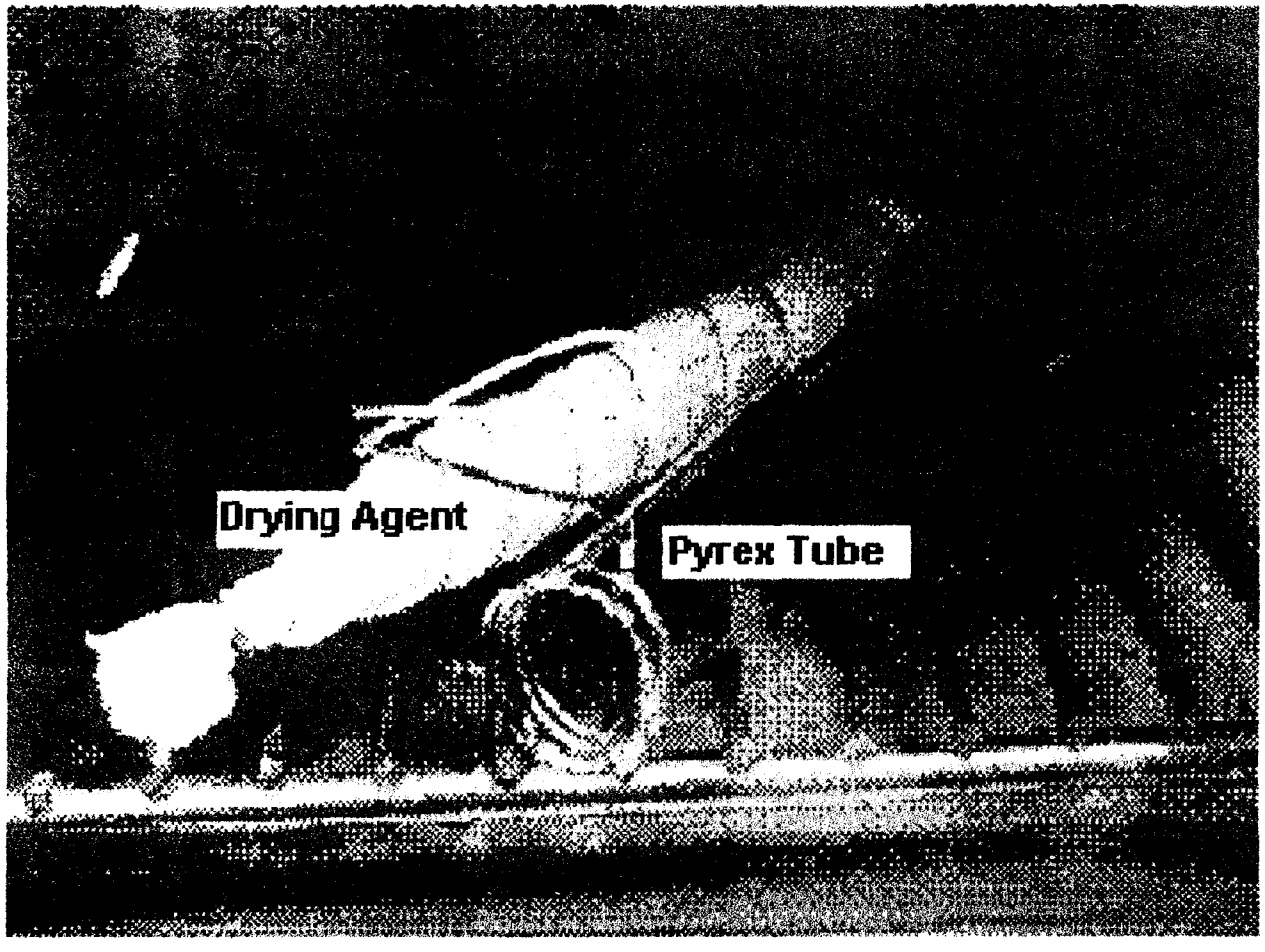
Encapsulated plastic material characteristics Absorption Spectrum



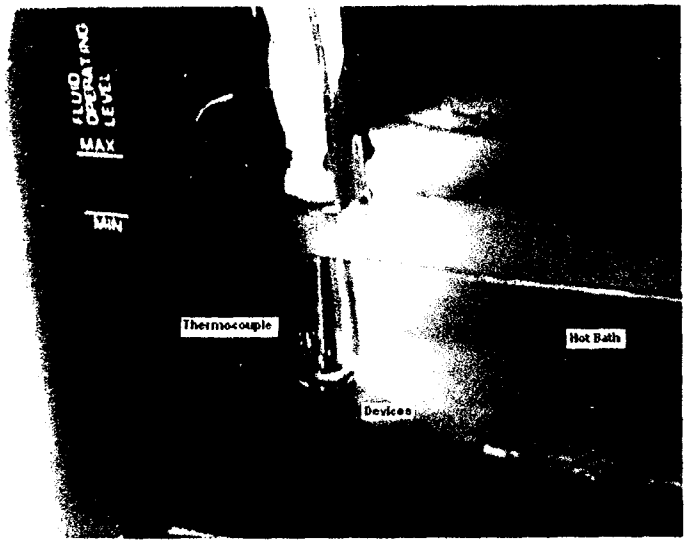
Test Methods

1. Temperature ramp rate was maintained to be 2.5 min/cycle.The tube was slowly dipped into the hot oil bath (135°C).
2. Once the thermocouple reading was reached to a level of saturation, the tube was taken out and dip slowly into the liquid nitrogen bath until the thermocouple reads -185 ° C.
3. Repeat the procedures of 1 and 2 for 29 times more. Examine the package at room temperature by a microscope and a SEM, at step 1 until 30 cycles are completed.

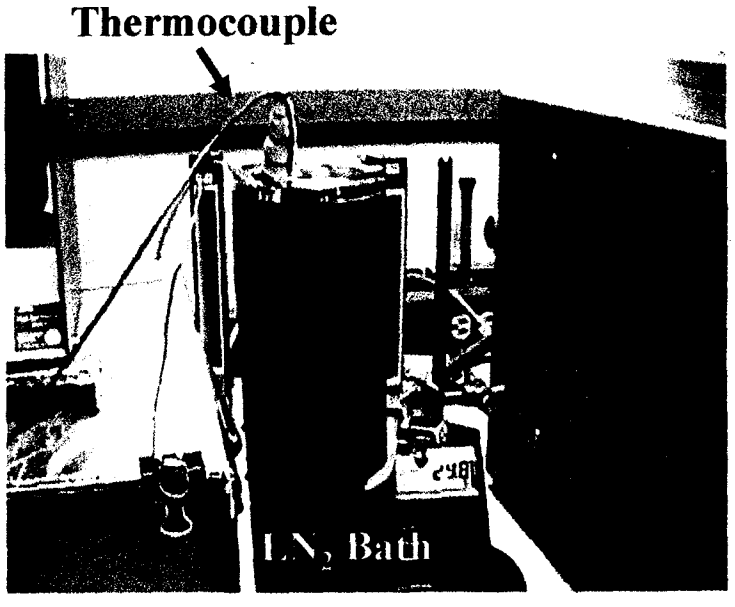
Sample Preparation



Test Set-up

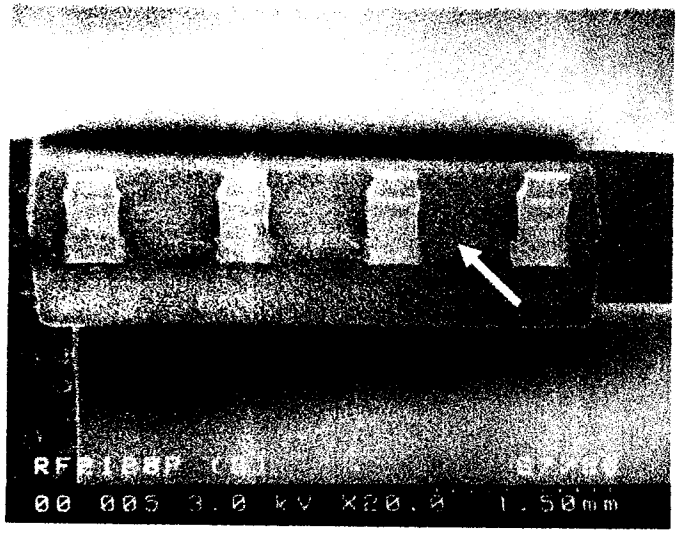


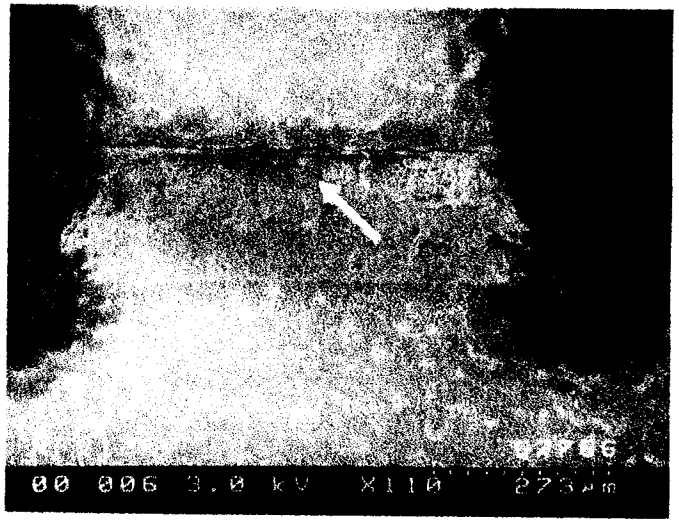
Hot Bath



Cold liquid nitrogen bath

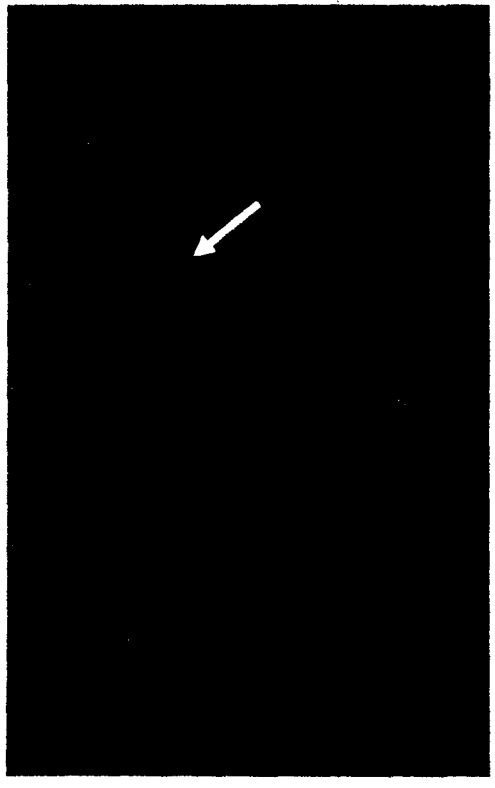
Spectral Examination after the Tests





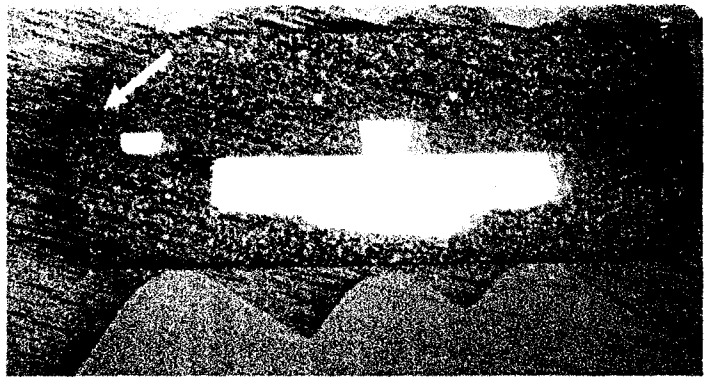
A miniature crack observed after the extreme environmental tests.

Optical View of the Cross Section

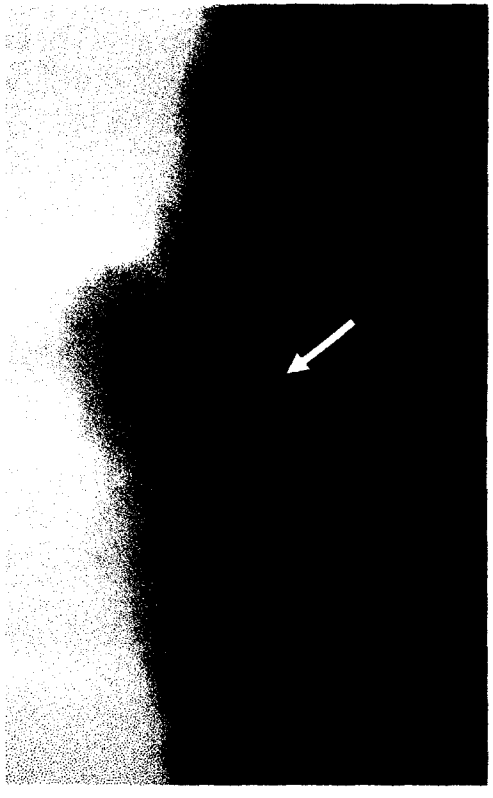


Optical Fluorescence
200X

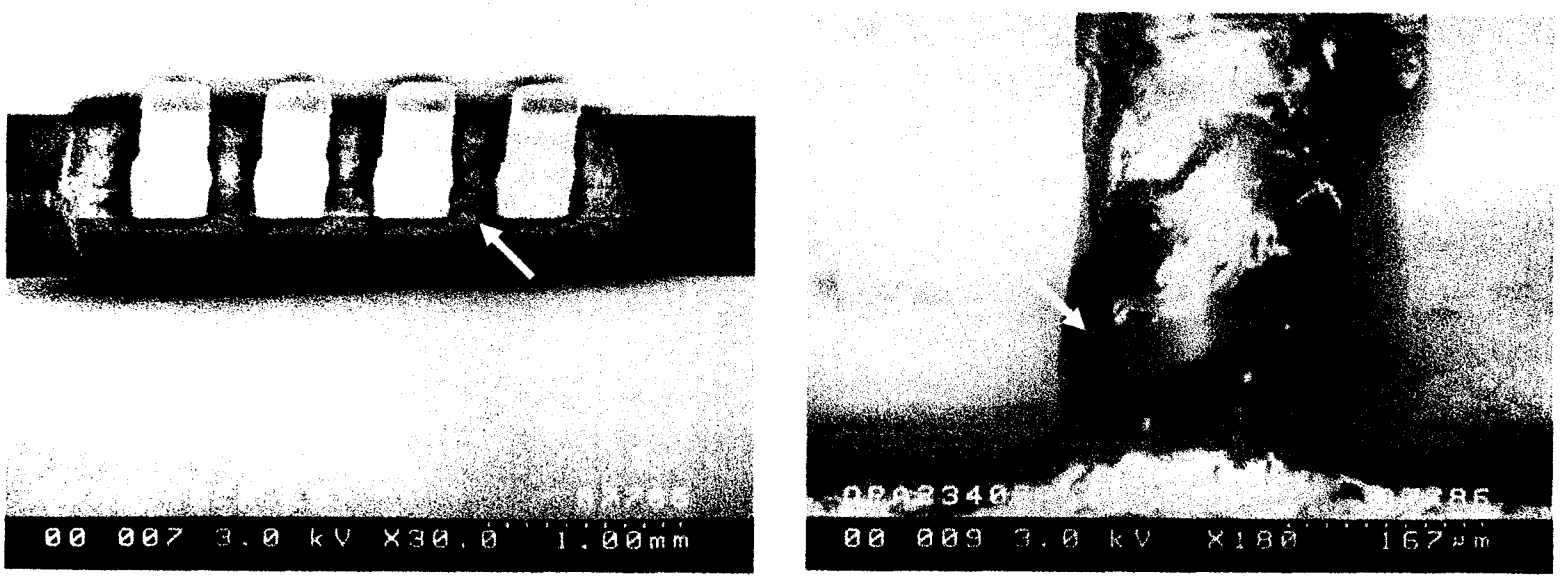
Optical Reflection



Optical Fluorescence
200X

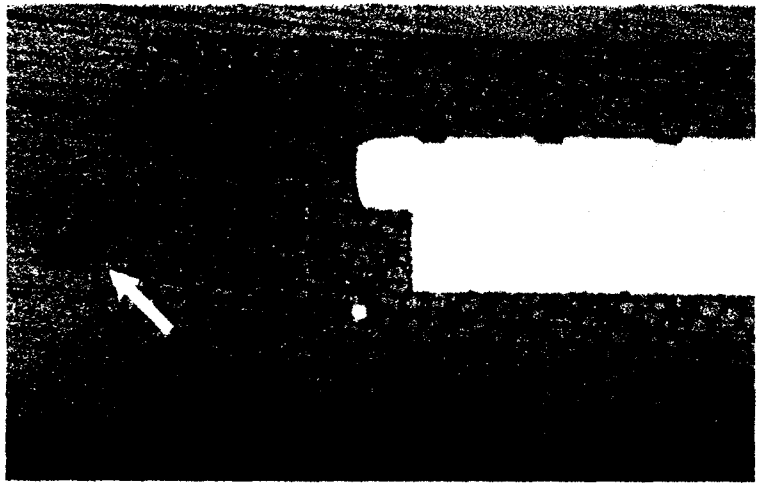


Spectral Examination after the Tests



A miniature crack observed after the extreme environmental tests.

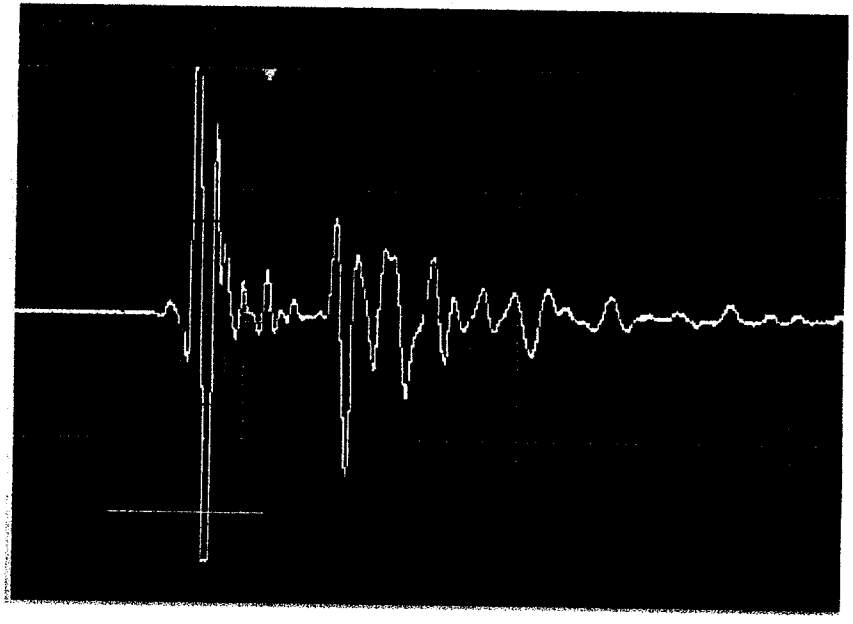
Optical View of the Cross Section



Optical Reflection, 200X

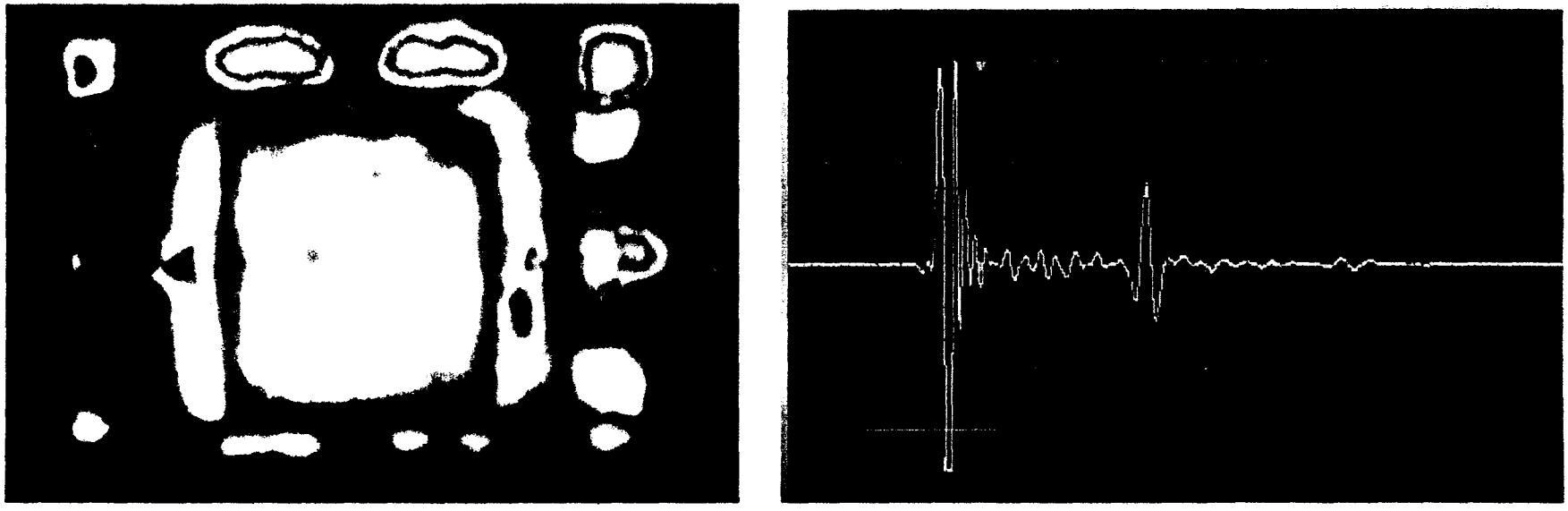
Optical Fluorescence, 200X

A Typical Image by C-SAM (1)



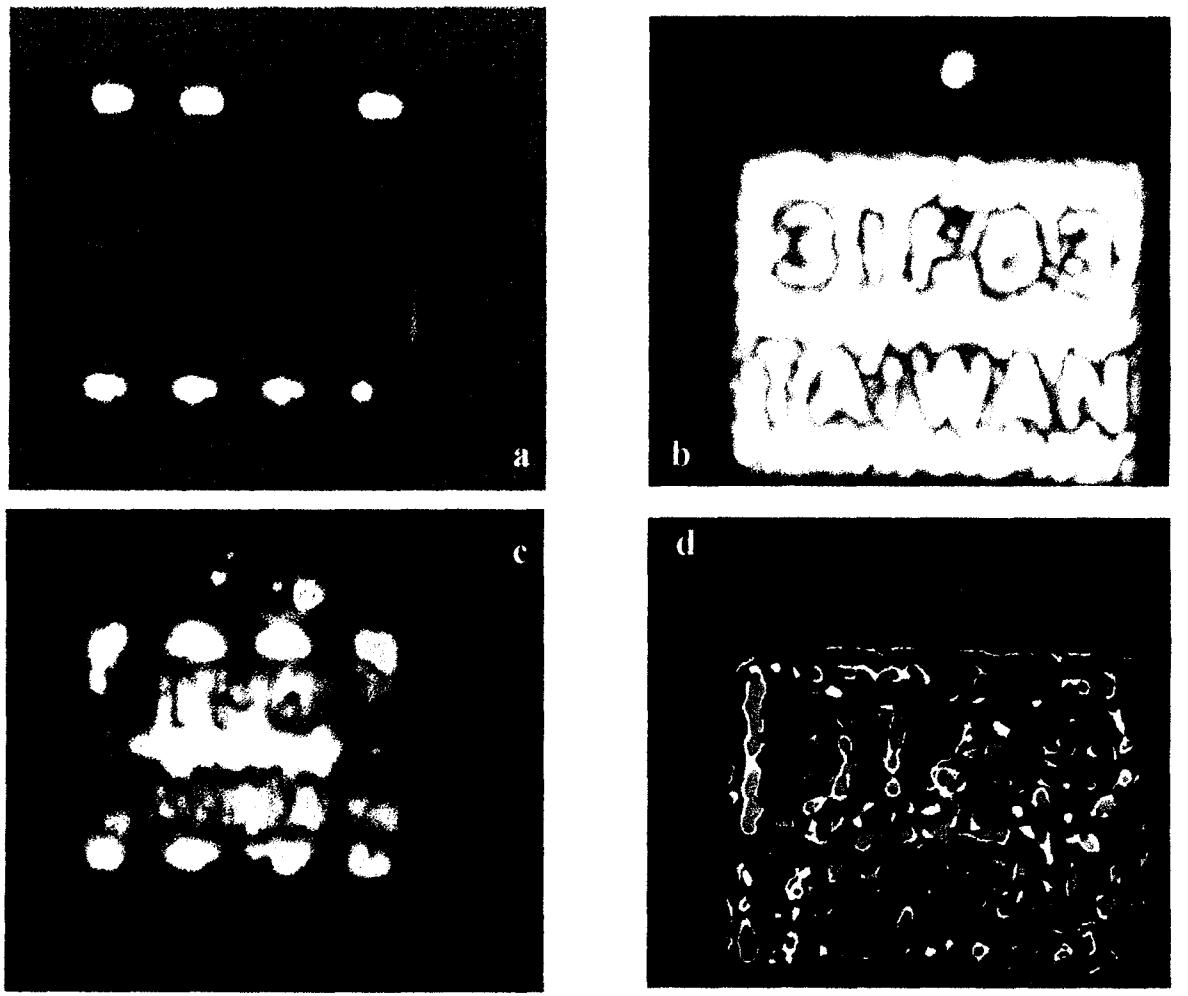
Acoustic wave reflection through the device material should be thoroughly documented prior to apply the C-SAM image to Reliability.

A Typical Image by C-SAM (2)



Acoustic wave reflection through the device material should be thoroughly documented prior to apply the C-SAM image to Reliability.

Various Images
Generated by Different Reflected Acoustic Waves



Conclusions

- **To our surprise, no defects or cracks were observed on ten (10) of the twelve samples. However, two (2) of the tested samples showed some indication of the miniature cracks as observed by SEM.**

- **C-mode Scanning Acoustic Microscope (C-SAM) can be an excellent non-destructive quality assurance tool to back up some electronic parts assurance if it is used consistantly under proper guidelines.**

- **Some improved plastic microelectronic parts can be used even in extreme space environments.**

Acknowledgements

The research described in this report was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

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